



U.S. ARMY ABERDEEN TEST CENTER



ATEC PROJECT NO. 2007-DT-ATC-XM22B-D7353  
TEST RECORD NO. WF-E-80

## ***Phase IV Jet Propellant (JP)-8***

### ***Fuel Performance Test***

### ***XM20 Bridge Erection Boat (BEB)***

***August 2008***



Nancy T. Castaldo  
Charlie C. Jones

Support Equipment Division, Warfighter Directorate

Prepared for:  
U.S. Army Tank-automotive and Armaments Command  
Warren, MI 48397-5000

U.S. Army Developmental Test Command  
Aberdeen Proving Ground, MD 21005-5055

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>01 AUG 2008</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>27 NOV 2007 - 17 JAN 2008</b>	
4. TITLE AND SUBTITLE <b>Phase IV Jet Propellant (JP)-8 Fuel Performance Test XM20 Bridge Erection Boat (BEB)</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S) <b>Nancy T. Castaldo Charlie C. Jones</b>			5d. PROJECT NUMBER <b>ATEC Project No. 2007-DT-ATC-XM22B-D7353</b>		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>U.S. Army Development Test Command Aberdeen Proving Ground, MD 21005-5055</b>			8. PERFORMING ORGANIZATION REPORT NUMBER <b>Test Record No. WE-E-80</b>		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) <b>US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000</b>			10. SPONSOR/MONITOR'S ACRONYM(S) <b>TACOM/TARDEC</b>		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S) <b>19501</b>		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>The original document contains color images.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>SAR</b>	18. NUMBER OF PAGES <b>6</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

**U.S. ARMY ABERDEEN TEST CENTER  
ABERDEEN PROVING GROUND, MARYLAND 21005-5059  
TEST RECORD**

ATEC Project No. 2007-DT-ATC-XM22B-D7353  
Type Test and Title: Phase IV Jet Propellant  
(JP)-8 Fuel Performance Test of the XM20  
Bridge Erection Boat (BEB)

Dates of Test: 27 November 2007 to  
17 January 2008  
Authority: ATEC Decision Support System,  
23 August 2007  
Test Record No. WF-E-80

---

**TEST ITEM**

The primary mission of the bridge erection boat (BEB) is to assist U.S. Army Multi-Role Bridge Company (MRBC) units in maneuvering, construction, and operation of the improved ribbon bridge (IRB) during bridging and rafting operations (fig. 1). As a secondary function, the BEB can be used for safety boat, troop and cargo transport, and patrol and reconnaissance missions. The BEB is a 27- by 8-ft aluminum hull, twin engine, twin hydrojet powered vessel. The XM20 BEB is powered by twin Cummins 6BTA 5.9-L, six-cylinder, four-cycle 260-hp marine diesel engines equipped with in-line fuel injection pumps.



Figure 1. XM20 BEB pushing a two-bay IRB raft.

The use of trade names in this document does not constitute an official endorsement or approval of the use of such commercial hardware or software. This document may not be cited for purposes of advertisement.

## SUPPORTING FACILITY

### Facility:

Spesutie Narrows Waterway, U.S. Army Aberdeen Test Center (ATC), Aberdeen Proving Ground (APG), Maryland.

## DETAILS OF TEST

a. Testing was performed from 27 November 2007 through 17 January 2008. This test was a follow-on effort to U.S. Army Test and Evaluation Command (ATEC) Project No. 2006-DT-ATC-BEBSX-D1897. The Mk II-R suffered numerous fuel injection pump failures when the boats were fueled with JP-8. The U.S. Army Tank-automotive and Armaments Command (TACOM) directed ATC to conduct a comparison test with two XM20 boats running on JP-8 fuel. The JP-8 fuel performance test was accomplished in accordance with the BEB Fuel Pump Test Plan, 26 June 2007, supplied by TACOM. The purpose of testing was to document the operational characteristics of the BEB engine and fuel systems during the performance of 23 aggressive duty cycles designed to emulate mission requirements.

b. The test objective was to determine if the Cummins XM20 engine and in-line fuel injection pump configuration were fully functional when operated with JP-8 fuel.

c. Initial Inspection and Test Preparation. Test system identification is presented in Table 1. A summary of the initial inspection and test preparation performed is listed in Table 2.

TABLE 1. TEST ITEM IDENTIFICATION

BEB	SERIAL NO.
XM20-4	0195
XM20-5	0508

TABLE 2. INITIAL INSPECTION SUMMARY AND TEST PREPARATION

EVENT	TIR NO. K2-D0000	BEB	REMARKS AND ACTIONS
Inspection and servicing	74	XM20-4	All engine, transmission, and hydrojet units were inspected for leaks and proper fluids levels. The fluid levels were adjusted as necessary. The engine oil filters, air filters, fuel filters, and Racor 30- $\mu$ fuel filters were changed.
	70	XM20-5	
Port exhaust extension leak	69	XM20-4	During the pretest functional operation, there was an exhaust leak on the port engine. The exhaust elbow was corroded beyond repair. The elbow was replaced with a used, but serviceable, elbow.

d. Duty Cycles. TACOM directed ATC to employ JP-8 fuel in the boats for the duration of testing. BEB duty cycles consisted of the following sequence of events:

(1) Simulated rafting - full throttle operation for 37 min while pushing a two-bay IRB raft in the conventional configuration (fig. 1).

(2) Induced aeration cycles were conducted for 3 min. From full throttle, full forward control, the driver moved the throttle controls to low idle, shifted the buckets to the full rearward position, and then immediately increased the throttles back to full revolutions per minute (rpm). While backing under full throttle, the operator immediately and quickly moved the throttles to minimum idle. The operator waited for the engine speed to reduce to minimum, and then the throttle was increased to half throttle to determine if the engines remained at idle or stalled, independent of throttle position. The engine(s) were restarted as necessary.

(3) Simulated bridge building/retrieval was conducted for 42 min. Eight varied throttle cycles were accomplished while pushing a two-bay IRB raft in the conventional configuration. Each cycle was composed of 5 min at full throttle, 30 sec at idle, 30 sec at full throttle, and 30 sec at idle.

(4) Simulated anchoring conducted for 11 min at half throttle in the forward direction while pushing a two-bay IRB raft in the conventional configuration.

(5) The IRB was disconnected from the BEB.

(6) Simulated patrol operations were conducted. The BEB was operated at full throttle, on plane, for 25 min.

(7) The bays to the BEB were reconnected.

(8) The steps in paragraphs d(1) through (6) were repeated to obtain a total of 271.5 min.

## **SUMMARY OF RESULTS**

a. System Operations. A summary of the total duty cycles and operational hours accomplished by the test boats is presented in Table 3. On 27 November 2007, TACOM redirected the system test requirement to only one XM20 boat. Operations continued with both boats for the remainder of the week. BEB XM20-5 suffered an engine shutdown on 30 November 2007 and test personnel selected BEB XM20-4 to continue the test program. There were no troubleshooting or repairs on BEB XM20-5.

b. System Test Data. Test preparation, inspections, and incident occurrences were recorded in Test Incident Reports (TIRs). A single test incident occurred on BEB XM20-4 (TIR No. K2-D000069). During cycle 19, step 8 (simulated rafting step, full throttle pushing two-bay raft), steam was emanating from the port engine. The temperature gauge was registering maximum temperature but no alarm sounded. The engine was immediately shut down and the emergency shutoff switch was engaged. A visual inspection revealed that the engine serpentine V-belt was displaced from the engine pulley, resulting in a disruption of water flow to cool the engine, causing the port engine to rapidly overheat. The boat was operated to the launching area using only the starboard engine. The boat was retrieved from the water and

transported to the maintenance facility. Inspection of the engine revealed a catastrophic engine failure due to extreme heat in the engine head and exhaust manifold. The port engine was replaced. The original fuel injection pump was installed on the replacement engine, and the fuel pump timing was adjusted by a Cummins engine representative. A 4-hr engine break-in was accomplished prior to restarting the duty cycle test operations.

TABLE 3. JP-8 DUTY CYCLE  
DURATIONS

BEB	TOTAL	
	HOURS <sup>a</sup>	DUTY CYCLES <sup>b</sup>
XM20-4	203.1	23
XM20-5	11.6	2:12
Total	214.7	25:12

<sup>a</sup>The hours were averaged between the port and starboard engines.

<sup>b</sup>Cycles:step.

c. Data Analysis. Two XM20 BEBs accrued a total of 214.7 hr without a JP-8 fuel-related incident.

SUBMITTED BY:

CHARLIE JONES  
Test Director

REVIEWED BY:

FOR THE COMMANDER:

NANCY T. CASTALDO  
Chief, Bridging, Watercraft and PAWS Team

DENNIS C. GRAHAM  
Chief, Support Equipment Division

Encl  
Distribution List

PM Bridging conducted full RAM testing of the XM20 BEB configuration in 2003. At the time of RAM testing, the boat failed reliability criteria due to several issues (engine and non-engine related) surfacing in test incidents. On Jan 24, 2004, PM Bridging finalized an agreement with the U.S Army Customer - Maneuver Support Center to close this variant due to inappropriate production site (cannot be built economically), testing became non-affordable, weight and technical problems with many design areas, including the hydraulic haul-in system. The demonstration conducted in 2008 was to verify the mission test profile using JP-8 fuel with other than rotary pumps.